

Nuclear Power

Nuclear power is a largely controversial topic in environmental physics as there are multiple pros and cons. It could be the future for our planet or just the same story as fossil fuels where it lasts for a couple hundred years or so then becomes high in demand and exceedingly expensive. Unfortunately nuclear power is not renewable as it uses radioactive “heavy” metals such as uranium as its fuel which is not very abundant with about two to four parts per million in the earth’s crust however still forty times more abundant than silver. Also for it to be economically viable to extract, it needs to be extracted in large quantities which can only be done in countries like Canada and Australia. Many countries with small amounts of uranium cannot extract it and make a profit.

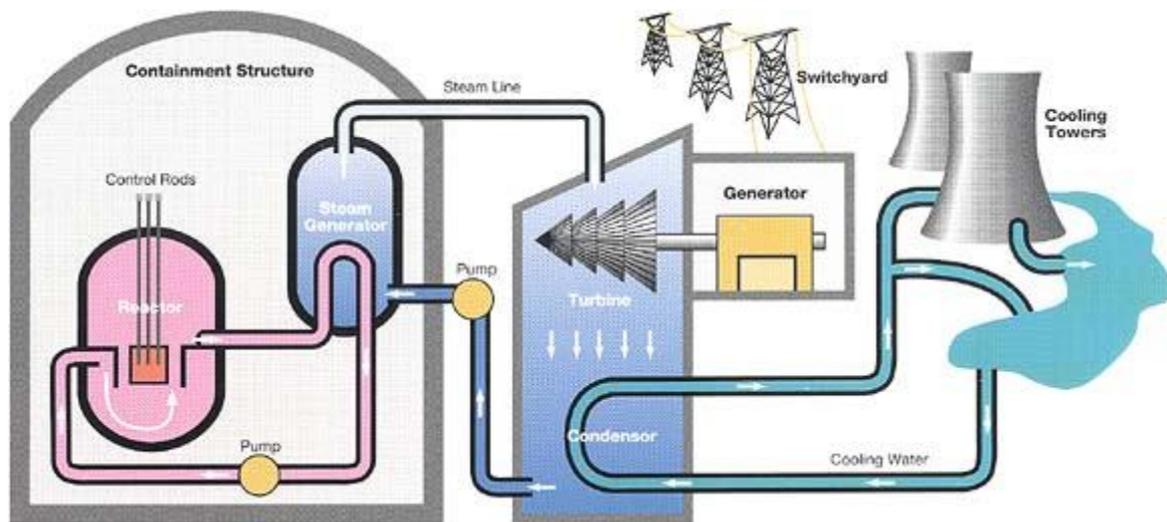


Typical appearance of a nuclear power plant.

There are two types of generating power using nuclear processes. They are essentially very simple concepts to understand. Firstly there is nuclear fission which is the process where neutrons are fired with incredible velocity at the nuclei of uranium, plutonium or thorium (these elements are used as they are radioactive, dense and very unstable therefore the nuclei are likely to split). The neutron splits the nucleus in half which releases incredibly large amounts of energy, two fission products which become radioactive nuclear waste and separate neutrons. These neutrons can be used further in nuclear chain reactions where the process of nuclear fission continues exponentially. Nuclear fusion is the process which occurs in the centre of stars. It is where hydrogen molecules, due to extreme pressure and temperature, collide with other hydrogen molecules and fuse together to form helium. Even more energy is released from nuclear fusion than nuclear fission and there are no harmful products like radioactive waste produced. Large amounts of research are being put into this process however no feasible solution has been developed so far. If a safe and stable nuclear fusion reactor is eventually developed, then it will completely revolutionise the planet as the fuel is

hydrogen, the most abundant element in the universe, so the process is renewable and there are no harmful waste products.

The main benefits of nuclear power are that it is more efficient than burning fossil fuels as the amount of energy released from uranium per gram is much more than that of fuels such as oil or coal; approximately 8,000 times more efficient in fact. Despite there being far less uranium reserves in the world compared to fossil fuel reserves, the potential amount of energy generated is still greater and there are no greenhouse gases released into the atmosphere. The minimal greenhouse gas emissions is probably the most appealing benefit of nuclear power as global warming is a very well-known and discussed issue nowadays. Although nuclear power isn't renewable, it still will provide a lot of energy for decades to come and it will have no harmful effect on our fragile atmosphere.



Simplified diagram of the nuclear fission process.

As hydrogen synthesis is difficult and solar and wind power do not generate sufficient energy along with other renewable processes; nuclear power is the right way forward today. Hydrogen is thought to be a very promising renewable fuel by many scientists and the public, it being the most abundant element in the universe; however insufficient research and testing has been done. Also it is not economical as hydrogen is expensive to retrieve as electrolysis of sea water requires a lot of electricity to split the water into oxygen anions and hydrogen cations.

Nuclear waste is the main drawback of nuclear power and is the remnants of the split uranium or other fuel and is highly unstable. It is radioactive so therefore is harmful to humans, animals and plants so consequently has to be sealed up and contained for hundreds of years before it is safe to deposit into the environment. However a lot of research is being put into either breaking it down into harmless substances or being able to store it safely, economically, subtly and for shorter periods of time.

Also nuclear power is potentially extremely dangerous. If not properly managed or built, a nuclear power station could inflict radiation poisoning and the nuclear reactor, being very unstable, could explode, killing the workers there and emitting radioactive fallout into the atmosphere. This circumstance has occurred before in Chernobyl, in Ukraine on 26th April 1986 and is considered to be

the worst nuclear power plant accident in history. The nuclear reactor vessel ruptured during a sudden power surge and multiple explosions followed. A plume of radioactive fallout spread first over the nearby town of Pripyat, killing or severely poisoning all of the citizens. The cloud then spread extensively over other areas of Ukraine, Belarus and Russia, contaminating the farm land, rivers and the natural environment. It also killed or harmed animals and humans. Over 350,000 people have been evacuated from areas at risk of contamination since the accident. This accident has emphasised how thorough the safety and managing needs to be of a nuclear power station as even a slight malfunction can be catastrophic. However despite rare accidents, nuclear power stations are relatively safe nowadays and everything is taken with extreme precaution.



The effect of the explosions at Chernobyl

The government have a crucial role in whether nuclear power stations are built or not. Generally they are keen to build nuclear power stations as it is a much more efficient way of generating energy and our country's oil and natural gas reserves are quite low. Also it offers employment which is very appealing in a situation like today's economic depression. However nuclear power stations are incredibly expensive to build and manage and uranium is very difficult and expensive to firstly find then mine safely. Also nuclear power plants usually last 40-60 years then are decommissioned which is a very costly and slow process. Nuclear power is widely discussed among our country's MPs and there is always a controversy; the same applies for the general public. However many people just associate nuclear power with very stereotypical views and are actually ignorant of the reality. They believe that nuclear power threatens them and the environment which is actually very over-exaggerated. The government however is typically in favour of nuclear power and currently new power plants are planned to be built as our current ones are all due to be decommissioned by 2025 which will unfortunately cost around £70 billion. They believe that our country shouldn't be too reliant on the Middle-East, Russia and other foreign countries for sources of energy and therefore should keep on building nuclear power stations which presently provide 20% of the country's electricity.

Uranium is the most popular radioactive actinide element used in the process of nuclear fission. However there are other alternative fuels that are rarely used such as the artificially made element plutonium and the the element thorium, which is actually three times more abundant than uranium and is found in the earth's crust. Uranium is only mined in a few countries globally as because uranium concentraions in the ground are so low, there are few places where uranium can be mined for a finacial benefit. The major uranium sourced and mined countries include Canada, Australia and Kazakhstan. The process of mining the uranium is a difficult and expensive one. It involves precise and specialised machinery and technology and years of planning and safety measures need to be issued before a mine may begin to be exploited.



Uranium mine



Uranium ore

In conclusion, nuclear power, despite its numerous negative factors, is the most prominent renewable electricity generation method with today's current technological era. There are other methods of electric generation which seem to be more plausible and are currently being researched and tested thoroughly. However nuclear power will suit our electrical needs better as sufficient research has been completed and the most efficient nuclear generators have been formulated to ensure maximum amounts of uranium used in the process and electrical generation. If nuclear power is properly developed and many more nuclear power stations are built, then countries will rely on it and fossil fuels will be less regularly used. Fossil fuels however will still be crucial for transport as nuclear power cannot power vehicles however a lot of money and greenhouse gas emissions will be saved in the long run.